PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

New or Improved Power Transmission Means for Vehicles

We, DAVID BROWN INDUSTRIES LIMITED, of Meltham Mills, Meltham, Huddersfield, in the County of York, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to power transmission means for vehicles, intended more particularly for tracklaying vehicles but also adapted to drive wheeled vehicles which are steered by positively altering the relative speed of the near-side and off-side driving wheels.

According to the invention, hydraulic power transmission means for a vehicle comprise a reversible motive pump driven by an engine on the vehicle and adapted to circulate liquid under pressure in a hydraulic circuit including a number of hydraulic motors in series, each of the motors being drivably connected to a road wheel or track sprocket, and means for by-passing the motor or motors adapted to transmit drive to the near side and off side respectively of the vehicle. Preferably, the volume of liquid delivered by the pump is variable. Each by-pass means preferably comprises a branch pipe through which some or all of the liquid under pressure can be diverted by manual adjustment of a two-way valve, which may conveniently be a rotary valve. The hydraulic circuit is preferably kept full of liquid by a priming pump driven by the vehicle engine and adapted to draw liquid from a sump and feed it into the circuit on both sides of the motive pump so that, regardless of the direction of flow of liquid through the motive pump, sufficient liquid is being fed into the circuit on the suction side of the motive pump to maintain the circuit free of air.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings of which:—

Fig. 1 is a diagrammatic plan view of a tracklaying vehicle with its power transmission control means so adjusted that it will travel in a straight line;

Fig. 2 is a diagrammatic plan view of part of the vehicle with its power transmission control means so adjusted that it will make a skid turn to the near side, and

Fig. 3 is a diagrammatic plan view of the same part of the vehicle with its power transmission control means so adjusted that it will make a skid turn to the off side.

The expression "skid turn" is herein intended to define a turn in which one track is stationary whilst the other is moving.

Referring now to Fig. 1, a motive pump 10 is drivably connected to an engine 11 on the vehicle. The volume of oil delivered by the pump 10 is infinitely variable from a given maximum down to zero, and the direction of oil flow through the pump is reversible. The pump 10 is disposed in a hydraulic circuit comprising a conduit 12 connecting one side of the pump to one side of a hydraulic motor 13 on the near side of the vehicle, a conduit 14 connecting the other side of the pump to one side of a hydraulic motor 15 on the off side of the vehicle, and a conduit 16 connecting together the other sides of the two hydraulic motors. The hydraulic motor 13 drives the near-side track 17 through reduction gearing 18 and a toothed sprocket 19, and the hydraulic motor 16 drives the off-side track 20 through reduction gearing 21 and a toothed sprocket 22. The ends of the tracks 17 and 20 remote from the toothed sprockets 19 and 22 are respectively carried by idler wheels 23 and 24.

A branch pipe 25 is adapted to by-pass the hydraulic motor 13 and a manually controllable rotary two-way valve 26 is located at the junc-

[*Price 3s. 6d.*]

Price 4s 6d

Price 25p

tion of the pipe 25 and the conduit 16. Another branch pipe 27 is adapted to by-pass the hydraulic motor 15 and a manually controllable rotary two-way valve 28 is located at the junction of the pipe 27 and the conduit 14. The valves 26 and 28 constitute power transmission control means. Maximum pressurer elief valves 29 and 30 are in communication respectively with the conduits 12 and 14, to avoid the building up of excessive pressure due to shock loading.

The hydraulic circuit thus far described does not include a sump, but is kept full of liquid at a minimum priming pressure, of say, 30 pounds per square inch by a priming pump 31 of relatively small capacity compared with the motive pump 10. The pump 31, which is driven by the engine 11, draws oil from a sump 32 and feeds it through a pipe 33 past non-return valves 34 and 35 into the conduits 12 and 14 whenever the pressure in the said conduits falls below the minimum priming pressure. The pressure in the pipe 33 is prevented from rising above the required minimum priming pressure by a relief valve 36 in communication with the said pipe.

Oil escaping through the relief valve 36 is returned to the sump 32, as is any oil which may escape through the maximum pressure relief valves 29 and 30.

The manner of operation of the above described embodiment is as follows:—

When the circuit through the hydraulic motors 13 and 15 is fully opened, the motors are in series and are thus synchronised and, assuming the ground resistance on each of the tracks 17 and 20 to be the same, the pressure drop across each motor will be half the pressure drop across the motive pump 10. If the ground resistance on one track differs from that on the other track, the total pressure drop across the two motors 13 and 15 will be distributed between them in proportion to the resistance encountered by the respective tracks, but will still equal the pressure drop across the pump 10. No differential action can take place and the vehicle thus moves in a straight line. The speed of the vehicle is positively controlled by turning both of the valve 26 and 28 an equal amount, or alternatively by varying the delivery of the motive pump 10.

If the driver of the vehicle now begins to turn one of the rotary two-way valves, for example the near-side one 26, part of the oil under pressure being supplied to the hydraulic motor 13 is diverted through the branch pipe 25 and the speed of the motor 13 decreases in proportion to the quantity of oil diverted. Thus the speed of the track 17 decreases and the vehicle turns to the near side. If the driver continues to turn the valve 26 until the branch pipe 25 is fully opened, as shown in Fig. 2, the speed of the motor 13 decreases until it stops completely due to hydraulic lock. Thus the track 17 also stops completely and a skid turn to the near side results. Actuation of the off-side two-way valve 28 between the positions shown in Figs. 1 and 3 will likewise result in a turn of controllable tightness to the off side.

When bringing the vehicle to rest, both of the valves 26 and 28 are turned until the branch pipes 25 and 27 are fully opened, resulting in both motors being subjected to hydraulic lock whereby movement of both tracks is completely arrested. Alternatively, the whole circuit may be subjected to hydraulic lock, with the same result, by reducing the delivery of the motive pump 10 to zero. The vehicle does not require conventional friction brakes for retardation or steering, but a parking brake is provided in case of any leakage in the circuit. This brake forms no part of invention and is not shown in the drawings.

The vehicle is caused to move forwards or backwards simply by reversing the direction of oil flow through the motive pump 10.

It will of course be understood that various modifications are possible within the scope of the claim appended thereto. In one such modified arrangement (not shown) wherein each wheel of a four-wheeled vehicle is individually driven by a hydraulic motor, one branch pipe and an associated rotary two-way valve are provided to control the by-passing of both motors driving the near-side wheels, and another branch pipe and an associated rotary two-way valve are provided to control the by-passing of both motors driving the off-side wheels. Thus the arrangement operates in exactly the same manner as the preferred embodiment hereinbefore described and illustrated.

WHAT WE CLAIM IS:—

1. Hydraulic power transmission means for a vehicle comprising a reversible motive pump driven by an engine on the vehicle and adapted to circulate liquid under pressure in a hydraulic circuit including a number of hydraulic motors in series, each of the motors being drivably connected to a road wheel or track sprocket, and means for by-passing the motor or motors adapted to transmit drive to the near side and off side respectively of the vehicle.

2. Hydraulic power transmission means according to Claim 1 wherein the pump is capable of delivering a variable volume of liquid.

3. Hydraulic power transmission means according to either of Claims 1 and 2 wherein each by-pass means comprises a branch pipe through which some or all of the liquid under pressure can be diverted by manual adjustment of a two-way valve.

4. Hydraulic power transmission means according to Claim 3 wherein rotary two-way valves are employed.

5. Hydraulic power transmission means according to any of Claims 1 to 4 wherein a

priming pump is adapted to draw liquid from a sump and feed in into the hydraulic circuit.

6. Hydraulic power transmission means according to Claim 5 wherein the priming pump is adapted to feed liquid into the hydraulic circuit on both sides of the motive pump.

7. Hydraulic power transmission means substantially as hereinbefore described with reference to, and as illustrated by, the accompanying drawings.

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PROVISIONAL SPECIFICATION

New or Improved Power Transmission Means for Vehicles

We, DAVID BROWN INDUSTRIES LIMITED, of Meltham Mills, Meltham, Huddersfield, in the County of York, a British Company, do hereby declare this invention to be described in the following statement:—

The invention relates to a method of power transmission by hydraulic means, intended more particularly for tracklaying vehicles but also adapted to drive wheeled vehicles which are steered by positively altering the relative speed of the near-side and off-side driving wheels.

According to the invention, a method of power transmission comprises the supplying of pressure liquid to a number of hydraulic motors in series, each motor being adapted to drive a road wheel or track sprocket, and partly or wholly diverting the liquid from one, some or all of the motors, when turning or stopping is desired, through by-pass means controlled by suitable valves.

Means for carrying out the method consist of a pump driven by an engine on the vehicle, preferably at variable speed, and delivering oil to a number of hydraulic motors arranged in series in the hydraulic system and each driving a road wheel or track sprocket, conveniently through gearing. Each motor, where a total of two such motors is provided as in a tracklaying vehicle, or each of two groups of motors, provided on the nearside and offside respectively as for example in a four-wheel-drive vehicle, can be bye-passed by a branch pipe controlled by a two-way valve, the valve being designed so that as it is changed over an increasing quantity of pressure liquid is diverted either to the bye-pass or through the motor.

There is no sump in the circuit, the whole system being kept full of liquid under pressure by a priming pump of relatively small capacity which is also driven by the vehicle engine and connected to the suction and delivery sides of the main pump by non-return valves. Thus, whether the main pump is running in a direction to transmit forward or reverse drive, there is always a pressure on the suction side and sufficient liquid being forced into the system at the point to maintain the circuit free of air.

A relief valve or valves will preferably be fitted at a suitable point or points in the circuit to avoid the building up of excess pressure due to shock loading.

The manner of operation will now be more particularly described, with reference, for the sake of convenience, to an arrangement employing a total of two hydraulic motors:—

When the circuit through the motors is fully opened, said motors are in series and are thus synchronised and, assuming the ground resistance on both of the tracks or driving wheels to be the same, the pressure drop across each motor will be half the pressure drop across the pump. If the ground resistance on each track or driving wheel varies, the total pressure drop across the two motors will be distributed between them in proportion to the resistance encountered by the respective tracks or driving wheels, but will still equal the pressure drop across the pump. No differential action can take place and the vehicle thus moves in a straight line.

If the driver of the vehicle now begins to change over one of the two-way valves, say the nearside one, part of the pressure liquid being supplied to the motor concerned is diverted through the associated bye-pass conduit and the motor loses speed in proportion to the quantity of liquid diverted. Thus the vehicle slews round in a left hand direction. If the valve continues to be changed over towards the position in which the bye-pass conduit is fully opened, the speed of the motor decreases until it stops completely due to hydraulic lock, and a skid turn results. Actuation of the offside valve control means will similarly result in a right hand turn of controllable tightness.

In order to bring the vehicle to rest, both valves are changed over to the fully open bye-pass position, resulting in both motors being subject to hydraulic lock.

The four-wheel-drive arrangement functions in exactly the same manner, but each of the nearside and offside valves controls a single

bye-pass conduit for the associated group of two motors in a series of four.

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863,560 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

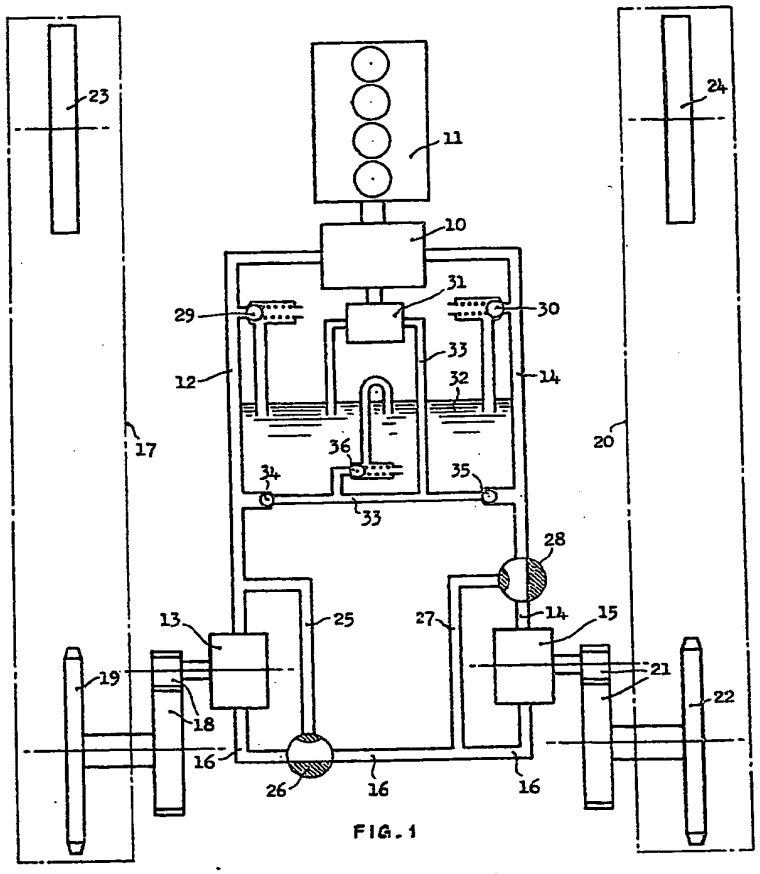

FIG. 1

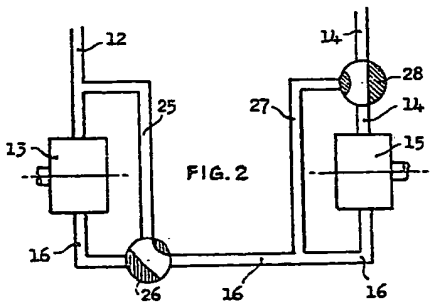

FIG. 2

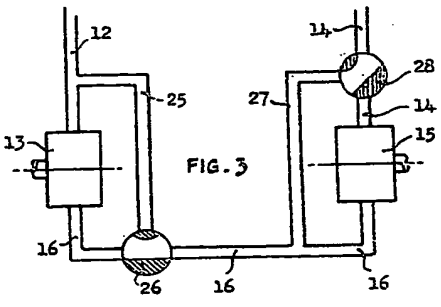

FIG. 3